AD-A188 191 STACK EMISSION TESTING FOR BERYLLIUM HILL AFB UTAH(U) 1/1
AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB
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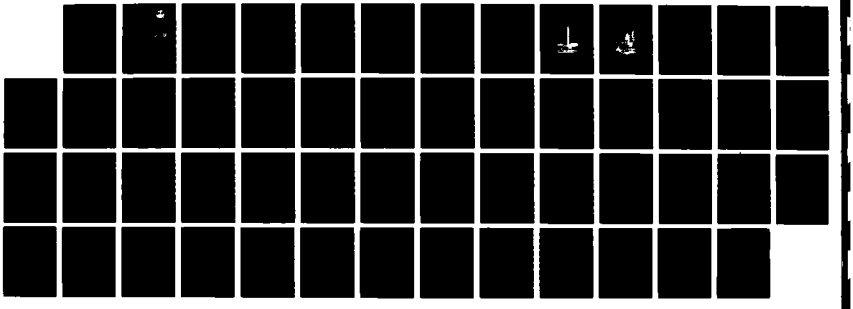

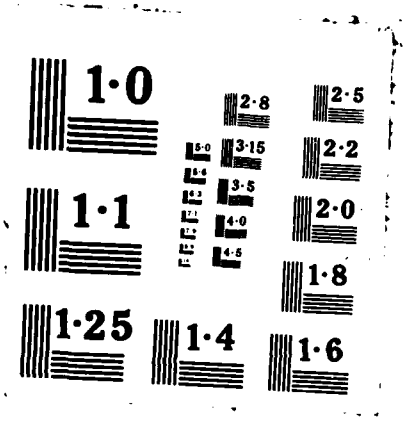
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USAFOEHL REPORT
87-144EQ0086LEF

STACK EMISSION TESTING FOR BERYLLIUM, HILL AFB UT

MARY M. DALY, Capt, USAF, BSC

November 1987

Final Report

USAF Occupational and Environmental Health Laboratory
Human Systems Division (AFSC)
Brooks Air Force Base, Texas 78235-5501

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This report has been reviewed and is approved for publication.

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

At the request of HQ AFLC/SGB, personnel from the USAFOEHL conducted an air emission survey of the exhaust from a C-5 brake reconditioning operation at Hill AFB UT from 13 July to 17 July 1987. These brakes contain beryllium disks and during the reconditioning process, beryllium particles are generated. The reconditioning operation consists of two processes which vent to individual stacks. The emissions for both stacks were well below the EPA standard for this kind-of operation.

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ILLUSTRATIONS

I. INTRODUCTION

On 13-17 July 1987, stack emission sampling of the exhaust from the C-5 brake reconditioning operation in Bldg 507 was accomplished at Hill AFB UT. These brakes contain beryllium disks and, during the reconditioning process, beryllium particles are generated. The survey was requested by HQ AFLC/SGB to determine the amount of beryllium being exhausted from the facility. Testing was conducted by the Air Quality Function of the USAF Occupational and Environmental Health Laboratory (USAFOEHL). Sampling team members are listed in Appendix A.

II. DISCUSSION

A. Background

The brake shop conducts a two-part reconditioning operation on C-5 beryllium brake discs. This operation consists of an active wet grinding process and a wet dipping process. The reconditioning process is a cyclic operation for six hours per day and the shop operates only one shift per day. Each process is exhausted through its own stack and has no air pollution control equipment.

B. Applicable Standards

The national Environmental Protection Agency (EPA) emission standard for beryllium applicable to stationary sources is found in Chapter 40, Code of Federal Regulations, Part 61.30 (40 CFR 61.30). This standard limits beryllium emissions to not more than 10 grams over a 24-hour period. The State of Utah defers to the standard established by the EPA.

C. Site Description

The process for reconditioning the beryllium disks of the C-5 brake assembly is: (1) dipping in a sodium hydroxide solution, (2) glass bead blasting, and (3) re-dipping in the solution. Both the blasting and the dipping processes occur in closed rooms with restricted access. The dipping tanks are exhausted directly to the atmosphere through a stack on the roof (referred to in this report as the east stack). The blasting is done in a sealed cabinet with attached gloves (glove box or hood) to manipulate the brake disks. The exhaust is passed through a stainless steel filter with a water spray, primarily to recover the glass beads, and then exhausted through a second stack on the roof (referred to as the west stack). Both exhaust stacks on the roof were sampled. Both stacks are similar with a diameter of 15.75 inches and an example of one is shown in Figure 1.

D. Testing Methodology

All sampling and analysis for beryllium were done according to the procedures contained in 40 CFR 60-61, Methods 1-5, and 104. Sampling ports were located 2.5 feet downstream and 2 feet upstream from air flow disturbances in accordance with EPA Method 1. Figure 2 shows a photograph of the sampling equipment and personnel at the site with a detailed schematic of

the Method 5 sampling train shown in Figure 3. A performance test on each stack consisted of the average of three two-hour sample runs with the sampling probe positioned at 25, 50 and 75 percent of the duct diameter.

Prior to sampling, preliminary velocity, stack temperature, and cyclonic flow checks of the flue gas were determined according to EPA Methods 1 and 2. These data are included in Appendixes B and C. The data from the preliminary evaluations were used to determine the sampling nozzle size necessary to satisfy isokinetic conditions.

Quality assurance testing was accomplished by calibration of: (1) nozzle diameter; (2) triple beam balance (to measure within 0.5 g); (3) meter box; (4) post test meter box; and (5) pitot tube (coefficient assigned, Cp 0.84). These data are included in Appendix D.

E. Results

Table 1 presents the results obtained during stack testing of the brake reconditioning operation. Results indicate that the beryllium emission rate from the east stack (exhausts dipping operation) was less than 0.028 grams per day (g/d) based on a detection limit of 1.25 micrograms. The emission rate from the west stack (exhausts blasting operation) was 1.78 g/d. Again, a day represents six hours of operation over a 24-hour period.

III. CONCLUSION

Based on the results of this survey, the beryllium emissions from the brake reconditioning operation are well below the EPA standards established in 40 CFR 61.30 of 10 g/d.

TABLE 1: SURVEY EMISSION RESULTS

Sample Site		Sample Date	Probe Location (%) (% Duct Diameter)	% of iso-kinetic Sampling	Emission Rate (g/d)	Avg Emission Rate (g/d)
East						
Run	1	17 Jul	25	99.9	<0.027	
	2	17 Jul	50	93.8	<0.029	
	3	17 Jul	75	93.1	<0.029	
						<0.028
West						
Run	1	15 Jul	25	96.3	0.76	
	2	16 Jul	75	107.0	1.25	
	3	16 Jul	50	93.1	3.28	
						1.78

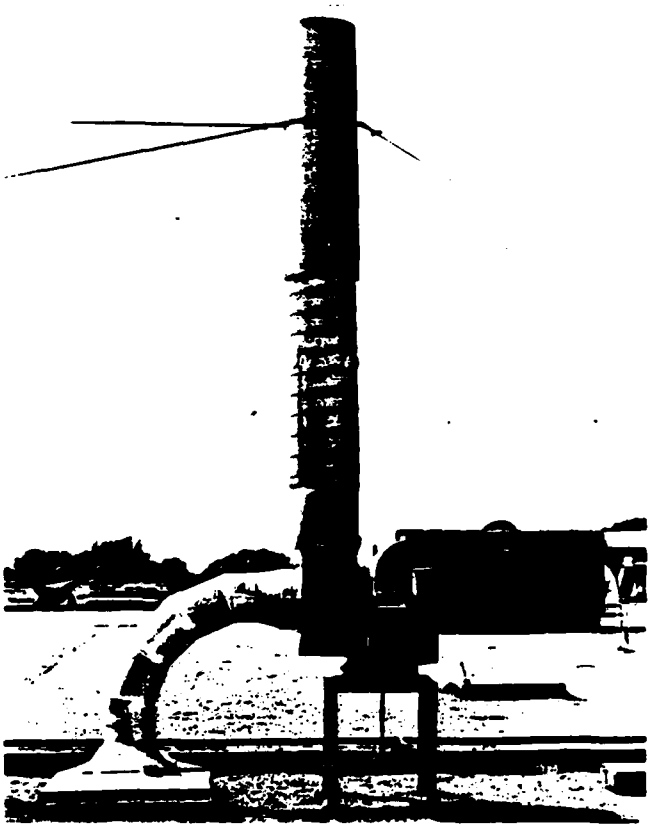

FIGURE 1: Sampling Site on the Roof

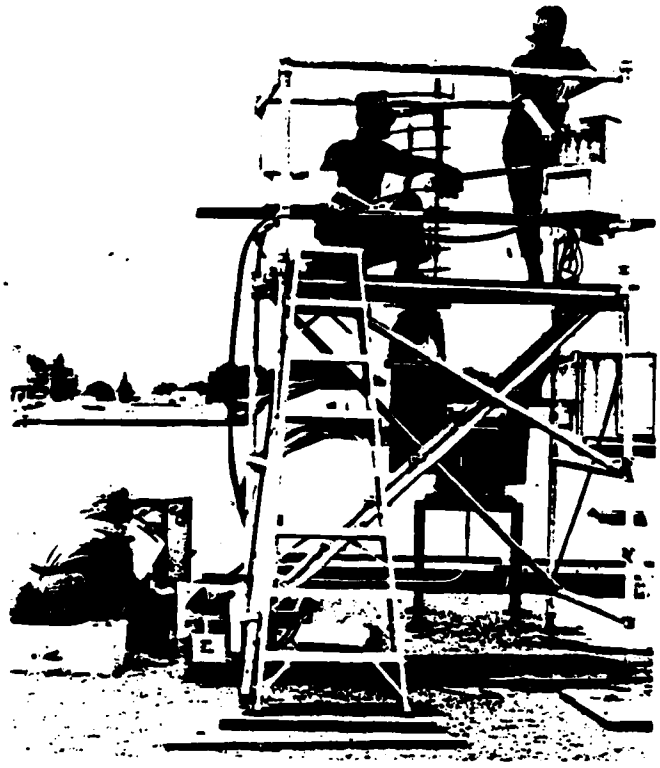

FIGURE 2: Sampling Equipment and Personnel

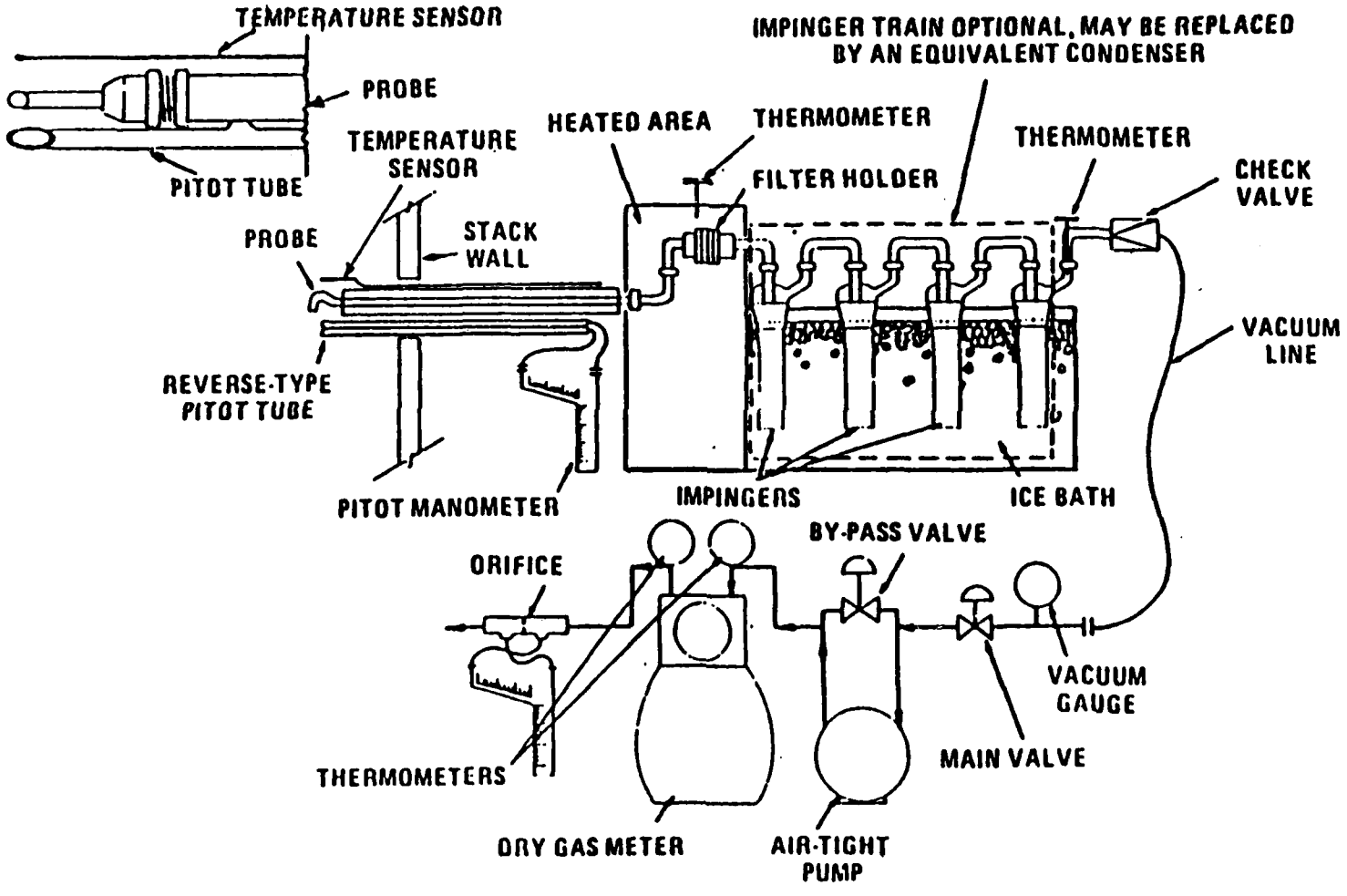

FIGURE 3: Method 5 Sampling Train

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Appendix A

TEST PARTICIPANTS

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TEST PARTICIPANTS

1. USAFOEHL/ECQ Sampling Team
   Brooks AFB TX 78235-5501
   (512) 536-2891

   Maj James Garrison
   Capt Guy Fagin
   Capt Mary Daly
   A1C Donald Johnson

2. Personnel Contacted

   Lt Col Phillip Brown, USAF Hosp Hill/SGPB
   Mr Willert Farrell, USAF Hosp Hill/SGPB
   Mr Dick Stiefkin, USAF Hosp Hill/SGPB
   Mr Robert Berger, OO-ALC/MANPGW

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Appendix B

SURVEY RAW DATA - East Stack

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PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE Hill	DATE 17 July
BOILER NUMBER East	
INSIDE STACK DIAMETER 15.75	Inches
STATION PRESSURE	In Hg
STACK STATIC PRESSURE East +0.07	In H20
SAMPLING TEAM	

TRAVERSE POINT NUMBER	VELOCITY HEAD V_p IN H20 Port A	$\sqrt{V_p}$ Port B	STACK TEMPERATURE (°F)
1	0.11	0.05	
2	0.11	0.05	
3	0.10	0.055	
4	0.095	0.065	
5	0.08 /0.075	0.085	
6	0.085	0.11	
7	0.185	0.20	
8	0.205	0.22	
9	0.205	0.225	
10	.195	0.225	
11	.175	0.215	
12	.175	0.215	
50%	0.13	0.16	
C = 1.15			
T_a = 80/63			
	W		
Velocity	.369/369/368		
Velocity	.372		
Vel Δp	.023 AVERAGE		

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: Run 1
DATE: 17 July 87
PLANT: east Be
BASE: 11/11 (1) B
SAMPLE BOX NUMBER: PHC
METER BOX NUMBER: Inlet
Qw/Qm:
Co:

SCHEMATIC OF STACK CROSS SECTION: @ 25% stack

120 min

leak @5" zero/min

stop 124.797
Start 42.416

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

AMBIENT TEMP: °F
STATION PRESS: 24.92 in Hg
HEATER BOX TEMP: °F
PROBE HEATER SETTING:
PROBE LENGTH: in
NOZZLE AREA (A): d = 0.361 sq ft
Cp:
DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H20)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0820	0.07	71		.075	1.7	42.416	65	64.5	64	233	70
2	0825		71		0.075	1.7	45.7	66	65	64	231	70
3	0830		70		0.08	1.8	49.1	68	66.5	65	232	70
4	0835		70		0.075	1.7	52.6	69	67	65	240	70
5	0840		71		0.075	1.7	56.0	71	68.5	66	246	70
6	0845		71		.075	1.7	59.4	73	70	67	248	70
7	0850		72		0.075	1.7	62.9	75	71.5	68	256	70
8	0855		73		0.075	1.7	66.3	76	73.5	69	262	70
9	0900		73		0.075	1.7	70.0	77	73.5	70	263	70
10	0905		74		0.075	1.7	73.2	78	74.5	71	254	70
11	0910		74		0.075	1.7	76.6	79	75	71	254	70
12	0915		74		0.075	1.7	80.0	79	75.5	72	264	70
13	0920		74		0.075	1.7	83.4	80	76.5	73	247	70
14	0925		74		0.075	1.7	86.85	80	76.5	73	241	70
15	0930		74		0.075	1.7	90.3	81	77.5	74	240	70
16	0935		75		0.075	1.7	93.8	82	78.5	75	242	70
17	0940		75		0.075	1.7	97.2	82	78.5	75	243	70
18	0945		75		0.075	1.7	100.6	83	79.5	76	243	70
19	0950		76		0.075	1.7	104.1	84	80	76	244	70
20	0955		76		0.075	1.7	107.5	84	80.5	77	247	70
21	1000		77		0.075	1.7	111.0	84	80.5	77	247	70
22	1005		78		0.075	1.7	114.4	85	81.5	78	243	70
23	1010		76		0.075	1.7	117.9	85	81.5	78	241	70
	1015		77		0.075	1.7	121.3	86	82.5	79	241	70

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2

DATE: 17 July 87

PLANT: East Ramp

BASE: Hill AFB

SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

at 50% traverse pt

120 nozzle

leak @ 6" Hg

zero leak

Stop 220.796

Start 124.956

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Pa \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

AMBIENT TEMP: °F

STATION PRESS: 24.90 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: in

NOZZLE AREA (A): sq ft

Cp:

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	10:50	0.07	87		.105	2.3	124.956	78	77.5	77	227	76
2	1055		81		.11	2.5	129.2	81	79.5	78	234	70
3	1100		77		.11	2.5	133.7	82	80	78	243	70
4	1105		88		.11	2.5	138.7	84	81	78	236	70
5	1110		[illegible]		.11	2.5	143.7	87	84.5	79	247	70
6	1115		[illegible]		.115	2.6	149.2	85	82	79	250	70
7	1120		81		.11	2.5	154.6	86	83	80	251	70
8	1125		80		.11	2.5	159.6	87	83.5	80	256	70
9	1130		80		.11	2.5	164.6	87	83.5	80	258	70
10	1135		81		.11	2.5	169.6	88	84.5	81	259	70
11	1140		80		.115	2.6	174.7	88	85	82	264	70
12	1145		80		.115	2.6	179.7	89	86	83	263	70
13	1150		79		.115	2.6	184.7	89	86	83	266	70
14	[illegible]		79		.115	2.6	189.7	90	87	84	266	70
15	1200		80		.115	2.6	194.7	91	87.5	84	270	70
16	1205		80		.115	2.6	199.7	92	88.5	85	266	70
17	1210		80		.12	2.7	204.8	92	89	86	262	70
18	1215		80		.12	2.7	209.8	93	89.5	86	263	70
19	1220		80		.11	2.5	214.6	93	90	87	260	70
20	[illegible]		82		.11	2.5	219.6	93	90	87	268	70
21	1230		83		.11	2.5	224.6	93	90	87	269	70
22	[illegible]		83		.115	2.6	229.8	93	90	87	264	70
23	1240		84		.115	2.6	234.8	94	91	88	267	70
OEHL FORM 18 MAY 78			0		.11	2.5	216.1	94	91	88	265	70

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 17 Jul 81

PLANT: Four

BASE: Hill AFB

SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

75% clearance p/(8)

120 min

leak 10" Hg
zero leak/min

Stop 360.591

Start 221.042

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot F\phi \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

Ref $\Delta p = 0.085$

AMBIENT TEMP: °F

STATION PRESS: 24.87 in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: in

NOZZLE AREA (A): .37 sq ft

Cp:

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F) (1)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP (6) (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (7) (°F)	SAMPLE BOX TEMP (3) (°F)	IMPINGER OUTLET TEMP (°F)
1	1320	.07	86		.21	4.1	221.042	89	89	89	226	70
2	1325		82		.225	4.65	226.1	92	90.5	89	250	70
3	1330		96		.23	4.8	213.7	96	93	90	260	70
4	1335		98		.23	4.8	237.4	97	94	91	266	70
5	1340		89		.235	4.9	243.2	98	94.5	91	252	70
6	1345		94		.235	4.9	248.9	98	95	92	261	70
7	1350		96		.23	4.8	254.7	100	96.5	93	237	70
8	1355		98		.23	4.9	260.5	100	96.5	93	256	70
9	1400		93		.235	4.9	266.2	99	96	93	257	70
10	1405		86		.24	5.0	272.0	99	96	93	261	70
11	1410		91		.24	5.0	277.8	99	96	93	256	70
12	1415		97		.24	5.0	283.7	100	97	94	250	70
13	1420		93		.24	5.0	289.5	101	97.5	94	247	70
14	1425		91		.245	5.2	295.4	101	97.6	94	247	70
15	1430		91		.245	5.2	301.3	103	99	95	248	70
16	1435		91		.24	5.0	307.3	104	100	96	247	70
17	1440		97		.24	5.0	313.2	104	100.5	97	244	70
18	1445		97		.24	5.0	319.3	104	100.5	97	244	70
	1450		91	85	.24	5.0	325.1	104	101	98	248	70
	1455		97		.245	5.2	331.0	105	101.5	98	245	70
	1500		97		.245	5.2	336.9	104	101	98	250	70
	1505		93		.245	5.2	342.9	104	101.5	98	247	70
	1510		93		.24	5.0	348.8	104	101.5	98	246	70
FHL / FORM MAT'66	1515	10	97	87	.24	5.0	354.7	106	102.5	99	248	70

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	17 July	I

BUILDING NUMBER	SOURCE NUMBER
East Be	East Be

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER millipore 5 W41 12			
ACETONE WASHINGS (Probe, Front Half Filter)			
BACK HALF (If needed)			
	Total Weight of Particulates Collected		gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	87	100	—
IMPINGER 2 (H20)	106	100	6
IMPINGER 3 (Dry)	5	0	5
IMPINGER 4 (Silica Gel)	~~220~~ 226.17	200.55	25.62
	Total Weight of Water Collected 424.17	400.55	~~36.62~~ 23.62 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	17 July 87	Run ~~II~~

BUILDING NUMBER	SOURCE NUMBER
East Be	

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER mill 6 / W41 13			
ACETONE WASHINGS *(Probe, Front Half Filter)*			
BACK HALF *(If needed)*			
	Total Weight of Particulates Collected		gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H2O)*	83 ~~87~~	100	0
IMPINGER 2 *(H2O)*	108 ~~106~~	100	~~6~~ 8
IMPINGER 3 *(Dry)*	2 ~~5~~	0	~~5~~ 2
IMPINGER 4 *(Silica Gel)*	227.92 ~~226.17~~	202.35	25.57
	Total Weight of Water Collected 420.92 − 402.35		18.57 ~~35.57~~

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2			733	671	imp + S.g.

unsl = ~~44~~ ml
H_2O 77 + 44

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO) 487 imp

OEHL FORM MAY 78 20

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	17 July	3

BUILDING NUMBER	SOURCE NUMBER
East Be	

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER M W41	7 14		
ACETONE WASHINGS (Probe, Front Half Filter)			
BACK HALF (If needed)			
	Total Weight of Particulates Collected		gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	~~62~~ 87	100	0
IMPINGER 2 (H20)	100	100	0
IMPINGER 3 (Dry)	6	0	6
IMPINGER 4 (Silica Gel)	235.00	202.29	32.71
	428 Total Weight of Water Collected	402.29	25.71 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Misc 88 ml H_2O

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

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Appendix C

SURVEY RAW DATA - West Stack

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PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE: Hill	PLANT: Pole Electric Site
DATE: 15 Aug 27	SAMPLING TEAM:
SOURCE TYPE AND MAKE:	
SOURCE NUMBER: Stack 1	INSIDE STACK DIAMETER: 15.75" Inches
RELATED CAPACITY:	TYPE FUEL:
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER: 15 3/4" Inches	
NUMBER OF TRAVERSES:	NUMBER OF POINTS/TRAVERSE:

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL (Inches) TRAVERSE A B	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT (Inches)
1	2.1		1"
2	6.7		1"
3	11.8		1.9
4	17.7		2.8
5	25.0		3.9 *
6	35.6		5.6
7	64.4		10
8	75.0		11.8 *
9	82.3		13.
10	28.2		13.9
11	13.3		14.75
12	97.9		15 → 14.75
	50.0		29 *

OEHL FORM APR 78 15

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE: Hill — DATE: 15 July 87

BOILER NUMBER: West

INSIDE STACK DIAMETER: 15.75" Inches

STATION PRESSURE: In Hg

STACK STATIC PRESSURE: + 0.04 Port A / 0.04 Port B In H20

SAMPLING TEAM:

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20 Port A	Port $\sqrt{V_p}$ B	STACK TEMPERATURE (°F)
1	0.02	0.035	
2	0.02	0.035	
3	0.025	0.045	
4	0.03	0.045	
5 *	0.03	0.055	
6	0.04	0.070	
7	0.10	0.125	
8	0.11	0.13	
9	0.10	0.13	
10	0.095	0.125	
11	0.085	0.125	
12	0.085	0.125	
	$\Delta H@ = 2.13$		
	T_m 84°F		
	$w\text{-}\Delta p = 0.03$		
	$C = 1.2$		
	$T_s = 80$		
d	80/59		
	Wall nozzle	0.475	
	AVERAGE Manifold	0.	

Ref ΔP 0.024

OEHL FORM APR 78 16

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE: Hill AFB

DATE: 16 July 81 (1200)

BOILER NUMBER: West 30

INSIDE STACK DIAMETER: Inches

STATION PRESSURE: In Hg

STACK STATIC PRESSURE: In H20

SAMPLING TEAM:

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H2O	$\sqrt{V_p}$	STACK TEMPERATURE (°F)
1	0.025		
2	0.025		
3	0.025		
4	0.030		
5	0.035		
6	0.045		
7	0.075		
8	0.065		
9	0.060		
10	0.060		
11	0.055		
12	0.055		
50%	0.065		
	AVERAGE		

OEHL FORM APR 78 16

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	1
DATE	15 July
PLANT	West Stack
BASE	IIII IIFB
SAMPLE BOX NUMBER	
METER BOX NUMBER	
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

Leak check 0.005/min

Sampling at 0.25% of stack diameter

Stop 877.830

Start 777.010

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

AMBIENT TEMP	°F
STAYION PRESS	in Hg
HEATER BOX TEMP	°F
PROBE HEATER SETTING	
PROBE LENGTH	in
NOZZLE AREA (A)	$\alpha = .498$ sq ft
Cp	1.2
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H20)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	1200	0.04	77		0.035	2.65	777.010	104	103.5	103	239	70
2	1205	7	94		0.035	2.65	781.2	103	103	103	250	70
3	1210	7	80		0.035	2.65	785.5	106	105	104	252	70
4	1215	7	82		0.035	2.65	789.8	109	107	105	252	70
5	1220	7	79		0.035	2.65	794.1	112	109	106	253	70
6	1225	7	82		0.035	2.65	798.45	114	111	108	249	70
7	1230	7	77		0.035	2.65	802.2	116	1125	109	249	70
8	1235	7	75		0.035	2.65	807.2	118	114	110	251	70
9	1240	7	74		0.035	2.65	811.5	119	115	111	256	70
10	1245	7	77		0.035	2.65	815.9	120	1165	113	252	70
11	1250	6	74		0.030/0.035	2.3/2.65	820.3	121	117	113	250	70
12	1255	7	74		0.035	2.65	824.5	121	1175	114	245	70
13	1300	6	71		.030	2.3	828.85	122	118.5	115	251	70
14	1305	6	73		.030	2.3	833.0	122	119	116	246	70
15	1310	6	78		.030	2.3	837.0	123	119.5	116	245	70
16	1315	6	82		.030	2.3	841.1	124	120.5	117	250	70
17	1320	6	82		0.030	2.3	845.2	124	121	118	250	70
18	1325	6	81		0.030	2.3	849.3	125	121.5	118	250	70
19	1330	6	72		0.030	2.3	853.4	125	122	119	244	70
20	1335	6	69		.030	2.3	857.45	125	122	119	243	70
21	1340	6	69		0.025	1.9	861.5	126	123.5	121	256	70
22	1345	6	70		0.030	2.3	865.3	126	123	121	254	70
23	1350	V	69		0.030	2.3	869.4	127	124	121	258	70
			6	74	0.035	2.65	873.4	127	124.5	122	247	70

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2

DATE: 16 July 87

PLANT: Unit Be

BASE: Hill AFB

SAMPLE BOX NUMBER: rac

METER BOX NUMBER: Nutech

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

at .75 traverse pt

zero leak/min

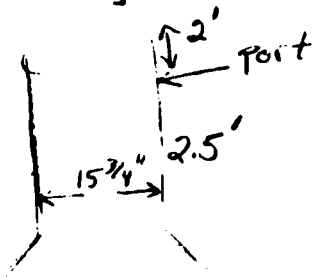
stop 922.392

start 878.051

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Pf \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$



AMBIENT TEMP: °F

STATION PRESS: in Hg

HEATER BOX TEMP: °F

PROBE HEATER SETTING:

PROBE LENGTH: in

NOZZLE AREA (A): d = 0.300 sq ft

Cp:

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0730	.04	82		.04	0.4	878.051	74	73	72	232	70
2	0735	3	82		.045	.45	879.8	74	73	72	245	70
3	0741	3	80		.05	.5	881.6	75	74	73	250	70
4	0745	3	78		.045	.45	883.5	79	77	75	248	70
5	0750	3	80		0.03	.3	885.35	81	78.5	76	251	70
6	0755	3	83		.045	.45	886.9	83	80	77	253	70
7	0800	3	83		.05	.5	888.6	85	82	79	258	70
8	0805	3	82		.05	.5	890.5	86	83	80	247	70
9	0810	3	85		.05	.5	893	89	85.5	82	244	70
10	0815	3	89		0.05	.5	894.4	90	86.5	83	246	70
11	0820	3	90		.035	.35	896.4	92	88.5	85	244	70
12	0825	3	91		.035/.04	.35/.45	898.1	93	89.5	86	243	70
13	0830	3	90		.045	.45	899.9	94	90.5	87	244	70
14	0835	3	87		.05	.5	902.0	95	92	89	241	70
15	0840	3	88		.045	.45	903.7	96	93	90	241	70
16	0845	3	87		.045	.45	905.6	97	93.5	90	242	70
17	0850	3	88		.035	.35	907.5	98	95	92	240	70
18	0855	3	89		.045	.45	909.2	98	95	92	248	70
19	0900	3	90		.045	.45	911.9	98	95.5	93	250	70
20	0905	3	88		.045	.45	912.9	99	96.5	94	248	70
21	0910	3	89		.045	.45	914.8	100	97.5	95	250	70
22	0915	3	91		.045	.45	916.7	100	98	96	246	70
23	0920	3	89		.035	.35	918.6	100	98	96	248	70
		3/4	89		.035/.09	.35/.9	920.3	101	98.5	96	249	70

OEHL FORM 18 MAY 78

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 16 July 87

PLANT: [illegible]

BASE: [illegible]

SAMPLE BOX NUMBER:

METER BOX NUMBER:

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

@ 50% traverse pt

115 mm Hg

1205 → 1400

leak 0 in mm

@ 11" Vac

Stop 1041.718

Start 923.143

EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Ts}{Ts} \cdot Vp$$

d = 0.5

Hg/in P 0.075

AMBIENT TEMP °F

STATION PRESS in Hg

HEATER BOX TEMP °F

PROBE HEATER SETTING

PROBE LENGTH in

NOZZLE AREA (A) sq ft

Cp

DRY GAS FRACTION (Fd)

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	1205	0.04 / 10 Vac	84		0.075	5.3	923.143	101	100	99	243	70
2	1210	10	85		0.075	5.3	—	101	100	99	243	70
3	1215	10	86		0.075 (0.065)	5.3/4.7	934.7	103	101	99	246	70
4	1220	6	85		0.035	2.6	940.6	105	102.5	100	244	70
5	1225	6	82		0.035	2.6	945.0	105	102.5	100	248	70
6	1230	9	84		0.065	4.7	949.3	108	103.5	100	246	70
7	1235	9	82		0.065	4.7	954.9	110	106	102	247	70
8	1240	9	85		0.065	4.7	960.7	111	107	103	247	70
9	1245	9	83		0.065	4.7	966.3	112	108.5	103	248	70
10	1250	6	89		0.035	2.6	972.0	112	108	104	247	70
11	1255	6	89		0.035	2.6	976.4	112	108	104	248	70
12	1300	7	76		0.05	3.6	980.7	114	110	106	248	70
13	1305	7	89		0.05	3.6	985.4	116	111.5	107	251	70
14	1310	7	93		0.05	3.6	990.7	116	111.5	107	251	70
15	1315	7	92		0.05	3.6	995.8	116	112	108	253	70
16	1320	6	83		0.035	2.6	1000.8	117	113	109	253	70
17	1325	6	87		0.035	2.6	1005.5	117	113.5	110	253	70
18	1330	7	91		0.055	4.0	1009.5	118	114	110	245	70
19	1335	8	97		0.055	4.0	1014.8	118	114	110	245	70
20	1340	9	97		0.065	4.7	1020.0	118	114.5	111	241	70
21	[illegible]	9	[illegible]		0.065	4.7	1025.9	118	115	112	247	70
22	[illegible]	7	[illegible] 95		0.05	3.6	1031.6	118	114	112	245	70
			102		0.05	3.6	1036.6	118	114	111	245	70

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	15 July	I West Stack

BUILDING NUMBER	SOURCE NUMBER
West	Be

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER 1	.2775	0.2715	
FILTER NUMBER 2			
ACETONE WASHINGS (Probe, Front Half Pitot)			
BACK HALF (If needed)			
	Total Weight of Particulates Collected		-

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H2O)	91	100	-9
IMPINGER 2 (H2O)	106	100	6
IMPINGER 3 (Dry)	5	0	5
IMPINGER 4 (Silica Gel)	228.48	201.72	26.76
	Total Weight of Water Collected 430.48 - 401.72		28.76 -

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Rinse H2O 121 ml

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	16 July	II

BUILDING NUMBER	SOURCE NUMBER
West	BE

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER 2 / 10	.2824	.2730	
ACETONE WASHINGS (Probe, Front Half Filter)			
BACK HALF (If needed)			
	Total Weight of Particulates Collected		gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	106	100	6
IMPINGER 2 (H20)	104	100	4
IMPINGER 3 (Dry)	1	Ø	1
IMPINGER 4 (Silica Gel)	212.05	201.36	10.69
— — —	Total Weight of Water Collected 423.05 − 401.36		21.69 gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Molecular Weight of Gas Stream 141

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Hill	16 July	3

BUILDING NUMBER	SOURCE NUMBER
West Be	

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER millipore what 41	4 .2758 11	.2743	
ACETONE WASHINGS (Probe, Front Half Filter)			
BACK HALF (If needed)			
	Total Weight of Particulates Collected		gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (H20)	87	100	0
IMPINGER 2 (H20)	108	100	8
IMPINGER 3 (Dry)	6	∅	6
IMPINGER 4 (Silica Gel)	231.85	205.02	26.83
	432.85 Total Weight of Water Collected	405.02	27.83 ~~40.83~~ gm

III. GASES (Dry)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Missed 1st 2 minutes

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

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Appendix D

QUALITY ASSURANCE - CALIBRATION DATA

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ANALYTICAL BALANCE CALIBRATION FORM

Balance name Mettler PC440 Number —

Classification of standard weights S Class

Date	0.500 g	1.0000 g	10.0000 g	50.0000 g	100.0000 g	Analyst
16 July	.50	1.00	10.00	50.00	100.00	[illegible]
17 July	.50	1.00	10.00	50.00	100.00	[illegible]

Quality Assurance Handbook M5-5.2

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 17 Mar 87 Meter box number Nutech

Barometric pressure, P_b = 28.941 in. Hg Calibrated by Moon + Daly

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter Inlet (t_{d_i}), °F	Temperature: Dry gas meter Outlet (t_{d_o}), °F	Temperature: Dry gas meter Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$ in. H_2O
0.5	4.651 5	49.533 44.882	69.4 68.9	77 73	72 70	533	13.5	1.08	2.10
1.0	4.658 5	55.036 50.378	70.3 69.1	82 78	74 72	536.5	9.6	1.08	2.11
1.5	7.377 10 5	61.254 55.882	68.9 70.7	88 83	78 75	541	15.8	1.085	2.13
2.0	9.495 10 7	5.417 66.012	67.8 69.4	93 89	82 79	545.75	13.8	1.09	2.14
3.0	9.427 10 7	85.799 76.372	70.3 68.2	98 94	85 83	550	11.3	1.09	2.14
4.0	9.251 10 7	03.753 99.502	68.5 68.5	80 75	71 70	534	9.75	1.08	2.18
							Avg	1.084	2.13

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Quality Assurance Handbook M4-2.3A (front side)

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 1 Date 6Oct87 Meter box number Nutech Plant Hill AFB

Barometric pressure, P_b = 29.379 in. Hg Dry gas meter number 1W4931-780005 Pretest Y 1.084

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$\frac{Y_i V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.0	10	960.667 951.277	68.2 / 68.7 / 528.45	73 79	69 72	73.25 / 533.25	19 22/60	13	1.072	
1.0	10	971.234 961.797	68.5 / 68.7 / 528.6	79 83	73 76	77.75 / 537.75	19 19/60	13	1.075	
1.0	10	981.084 971.611	68.7 / 68.7 / 528.7	83 86	76 78	80.75 / 540.75	19 21/60	13	1.077	
									Y = 1.075	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

NOZZLE CALIBRATION DATA FORM

Date 15, 16, 17 July Calibrated by [signature]

Nozzle identification number	Nozzle Diameter[a]			ΔD,[b] mm (in.)	D_{avg}[c]
	D_1, mm (in.)	D_2, mm (in.)	D_3, mm (in.)		
0.375 (east)	0.369	0.369	0.368	0.001	0.369
0.500 (west)	0.498	0.497	0.498	0.001	0.498
0.300 (west)	0.299	0.301	0.300	0.002	0.300
0.500 (west)	0.499	0.500	0.500	0.001	0.500

where:

[a] $D_{1,2,3}$ = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

[b] ΔD = maximum difference between any two diameters, mm (in.), $\Delta D \leq$ (0.10 mm) 0.004 in.

[c] D_{avg} = average of D_1, D_2, and D_3.

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Appendix E

CALCULATIONS

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CALCULATIONS

This formula was used to calculate the emission rate, R.

$$R = (K)\frac{W_t \; V_s \; A_s \; (86{,}400 \times 10^{-6}) \; P_s}{(V_m \text{ std} + V_w \text{ std}) \; T_s}$$

where: W_t = total weight of beryllium collected (micrograms, µg)

A_s = stack surface area (square feet, ft^2)

V_s = average stack gas velocity (feet per second, ft/s)

V_m std = dry gas sample volume at standard conditions (29.92 in Hg; 77°F)

V_w std = water vapor volume at standard conditions (cubic feet, ft^3

T_s = stack temperature (degrees Rankine, °R)

P_s = absolute stack gas pressure (inches of mercury, in Hg)

R = beryllium emission rate (grams per day, g/d)

K = 17.64 °R/in Hg

86,400 = conversion factor (seconds per day)

10^{-6} = conversion factor (g/µg)

OPERATING PARAMETERS

Sample		Wt (µg)	A_s (ft^2)	V_s (ft/s)	V_m std (m^3)	V_w std (m^3)	T_s (°R)	P_s (in Hg)
East								
Run	1	<1.25	1.35	17.02	73.786	1.11	533.8	24.93
	2	<1.25	1.35	20.97	84.285	0.87	542.3	24.91
	3	<1.25	1.35	30.57	120.846	1.21	547.1	24.88
West								
Run	1	60.86	1.35	11.13	84.879	1.35	537.7	25.18
	2	40.455	1.35	13.03	38.818	1.02	546.2	25.05
	3	246.17	1.35	14.46	100.946	1.31	546.6	25.03

where: Wt = weight

A_s = stack cross-sectional area

V_s = stack velocity

V_m std = meter volume at standard conditions (29.92 in Hg; 77°F)

V_w std = water vapor volume at standard conditions

T_s = stack temperature

P_s = absolute stack gas pressure

EAST STACK CALCULATIONS RUN #1, 2, and 3

XROM METH 5		XROM METH 5		XROM METH 5	
Run Number East 1		Run Number East 2		Run Number East 3	
	Run		Run		Run
METER BOX Y?		METER BOX Y?		METER BOX Y?	
1.0840	Run	1.0840	Run	1.0840	Run
DELTA H?		DELTA H?		DELTA H?	
1.7000	Run	2.5500	Run	4.9400	Run
BAR PRESS ?		BAR PRESS ?		BAR PRESS ?	
24.9200	Run	24.9000	Run	24.8700	Run
METER VOL ?		METER VOL ?		METER VOL ?	
82.3810	Run	95.8400	Run	139.5490	Run
MTR TEMP F?		MTR TEMP F?		MTR TEMP F?	
74.9000	Run	85.7000	Run	97.4000	Run
% OTHER GAS REMOVED BEFORE DRY GAS METER?		% OTHER GAS REMOVED BEFORE DRY GAS METER?		% OTHER GAS REMOVED BEFORE DRY GAS METER?	
0.000	Run	0.000	Run	0.000	Run
STATIC HOH IN?		STATIC HOH IN?		STATIC HOH IN?	
.0700	Run	.0700	Run	.0700	Run
STACK TEMP.		STACK TEMP.		STACK TEMP.	
73.8000	Run	82.3000	Run	87.1000	Run
ML. WATER		ML. WATER		ML. WATER	
23.6200	Run	18.5700	Run	25.7100	Run
IMP. % HOH = 1.5		IMP. % HOH = 1.0		IMP. % HOH = 1.0	
% HOH = 1.5		% HOH = 1.0		% HOH = 1.0	
% CO_2		% CO_2		% CO_2	
0.0000	Run	0.0000	Run	0.0000	Run
% OXYGEN		% OXYGEN		% OXYGEN	
21.0000	Run	21.0000	Run	21.0000	Run
% CO?		% CO?		% CO?	
0.0000	Run	0.0000	Run	0.0000	Run

XROM METH 5

Run Number
East 1

Run

MOL WT OTHER?
79.0000 Run

Mwd = 28.84
MW WET = 28.68

SQRT PSTS?
6.3359 Run

TIME MIN?
120.0000 Run

NOZZLE DIA?
.3690 Run

STK DIA INCH?
15.7500 Run

* VOL MTR STD = 73.786
STK PRES ABS = 24.93
VOL HOH GAS = 1.11
% MOISTURE = 1.48
MOL DRY GAS = 0.985
% NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.68
VELOCITY FPS = 17.02
STACK AREA = 1.35
STACK ACFM = 1,381.
* STACK DSCFM = 1,121
% ISOKINETIC = 99.95

XROM METH 5

Run Number
East 2

Run

MOL WT OTHER?
79.0000 Run

Mwd = 28.84
MW WET = 28.73

SQRT PSTS?
7.8096 Run

TIME MIN?
120.0000 Run

NOZZLE DIA?
.3690 Run

STK DIA INCH?
15.7500 Run

* VOL MTR STD = 84.285
STK PRES ABS = 24.91
VOL HOH GAS = 0.87
% MOISTURE = 1.03
MOL DRY GAS = 0.990
% NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.73
VELOCITY FPS = 20.97
STACK AREA = 1.35
STACK ACFM = 1,702.
* STACK DSCFM = 1,365.
% ISOKINETIC = 93.78

XROM METH 5

Run Number
East 3

Run

MOL WT OTHER?
79.0000 Run

Mwd = 28.84
MW WET = 28.73

SQRT PSTS?
11.3826 Run

TIME MIN?
120.0000 Run

NOZZLE DIA?
.3690 Run

STK DIA INCH?
15.7500 Run

* VOL MTR STD = 120.846
STK PRES ABS = 24.88
VOL HOH GAS = 1.21
% MOISTURE = 0.99
MOL DRY GAS = 0.990
% NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.73
VELOCITY FPS = 30.57
STACK AREA = 1.35
STACK ACFM = 2,482.
* STACK DSCFM = 1,972
% ISOKINETIC = 93.10

WEST STACK CALCULATIONS RUN #1, 2, 3

XROM METH 5

Run Number
West 1

Run

METER BOX Y?
1.0840 Run

DELTA H?
2.4600 Run

BAR PRESS?
25.1800 Run

METER VOL?
100.8200 Run

MTR TEMP F?
116.2500 Run

% OTHER GAS
REMOVED BEFORE
DRY GAS METER?
0.0000 Run

STATIC HOH IN?
.0400 Run

STACK TEMP.
77.7000 Run

ML. WATER?
28.7600 Run

IMP. % HOH = 1.6

% HOH = 1.6

% CO_2?
0.0000 Run

% OXYGEN?
21.0000 Run

% CO?
0.0000 Run

XROM METH 5

Run Number
West 2

Run

METER BOX Y?
1.0840 Run

DELTA H?
.4300 Run

BAR PRESS?
25.0500 Run

METER VOL?
44.3410 Run

MTR TEMP F?
88.0600 Run

% OTHER GAS
REMOVED BEFORE
DRY GAS METER?
0.0000 Run

STATIC HOH IN?
.0400 Run

STACK TEMP.
86.2000 Run

ML. WATER?
21.6900 Run

IMP. % HOH = 2.6

% HOH = 2.6

% CO_2?
0.0000 Run

% OXYGEN?
21.0000 Run

% CO?
0.0000 Run

XROM METH 5

Run Number
West 3

Run

METER BOX Y?
1.0840 Run

DELTA H?
3.9200 Run

BAR PRESS?
25.0300 Run

METER VOL?
118.5750 Run

MTR TEMP F?
108.9000 Run

% OTHER GAS
REMOVED BEFORE
DRY GAS METER?
0.0000 Run

STATIC HOH IN?
.0400 Run

STACK TEMP.
86.6000 Run

ML. WATER?
27.8300 Run

IMP. % HOH = 1.3

% HOH = 1.3

% CO_2?
0.0000 Run

% OXYGEN?
21.0000 Run

% CO?
0.0000 Run

XROM METH 5

Run Number
West 1

Run

MOL WT OTHER?
79.0000 Run

MWd = 28.84

MW WET = 28.67

SQRT PSTS?
4.1632 Run

TIME MIN?
120.0000 Run

NOZZLE DIA?
.4980 Run

STL DIA INCH?
15.7500 Run

* VOL MTR STD = 84.879
STK PRESABS = 25.18
VOL HOH GAS = 1.35
% MOISTURE = 1.57
MOL DRY GAS = 0.984
%NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.67
VELOCITY FPS = 11.13
STACK AREA = 1.35
STACK ACFM = 903.
* STACK DSCFM = 735.
% ISOKINETIC = 96.34

XROM METH 5

Run Number
West 2

Run

MOL WT OTHER?
79.0000 Run

MWd = 28.84

MW WET = 28.56

SQRT PSTS?
4.8527 Run

TIME MIN?
120.0000 Run

NOZZLE DIA?
.3000 Run

STK DIA INCH?
15.7500 Run

* VOL MTR STD = 38.818
STK PRES ABS = 25.05
VOL HOH GAS = 1.02
% MOISTURE = 2.56
MOL DRY GAS = 0.974
% NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.56
VELOCITY FPS = 13.03
STACK AREA = 1.35
STACK ACFM = 1,058.
* STACK DSCFM = 834.
% ISOKINETIC = 106.96

XROM METH 5

Run Number
West 3

Run

MOL WT OTHER?
79.0000 Run

MWd = 28.84

MW WET = 28.70

SQRT PSTS?
5.3965 Run

TIME MIN?
115.00 Run

NOZZLE DIA?
.5000 Run

STK DIA INCH?
15.7500 Run

* VOL MTR STD = 100.946
STK PRES ABS = 25.03
VOL HOH GAS = 1.31
% MOISTURE = 1.28
MOL DRY GAS = 0.987
% NITROGEN = 79.00
MOL WT DRY = 28.84
MOL WT WET = 28.70
VELOCITY FPS = 14.46
STACK AREA = 1.35
STACK ACFM = 1,174.
* STACK DSCFM = 936.
% ISOKINETIC = 93.07

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